PATENT SPECIFICATION

DRAWINGS ATTACHED

844,145

Date of Application and filing Complete Specification Nov. 20, 1958.

No. 37409/58.

Application made in Germany on Nov. 26, 1957.

Complete Specification Published Aug. 10, 1960.

Index at Acceptance:—Class 108(2), D6(E:F).

International Classification:—B62d.

COMPLETE SPECIFICATION

Improvements relating to Spring Suspension Compensating Arrangements for Vehicles

We, DAIMLER-BENZ AKTIENGESELLSCHAFT of Stuttgart-Untertürkheim, Germany, a company incorporated under the laws of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to spring suspension compensating arrangements for vehicles, more particularly motor vehicles. According to the present invention such a compensating arrangement is characterized in that there extends from each individual wheel suspension a bifurcated connection providing two branches, one branch being adapted for the transmission of force from its wheel suspension to a spring common to all of the suspensions and the other branch being adapted for the transmission of force from its wheel suspension to a device adapted for producing a predetermined relationship between the forces received by the individual wheel suspensions. Hence springing characteristics, for instance, hardness, vibration frequency, and so on, can be readily adapted as required to various kinds of movement, for instance:— parallel springing relatively to the road, pitching, rolling etc. and to the required kind of driving, for instance, oversteer, understeer etc.. If the spring common to all suspensions is rendered soft, for example, a soft parallel springing relatively to the road is provided, while the springing for pitching movements (braking, starting) and rolling movements (inclination on curves) remains hard, the said spring being unaffected by pitching or rolling. Also, by means of the compensating arrangement the relationship between the loading on the two front wheels and the different loading on the two back wheels can be determined so that oversteer or understeer can be controlled as required when the vehicle is travelling around curves.

Where the forces are transmitted by a hydraulic or a pneumatic medium, the compensating device may comprise two pistons working in cylinders, the two sides of each piston having different operative surfaces acted upon respectively by pressure produced by one front wheel and by one back wheel. The two pistons may be interconnected by a rod extending through a partition between the two cylinders which are disposed end to end.

The spring common to all suspensions may be a hydro-pneumatic spring which is acted upon by an element such as a ram which in turn is acted upon by individual elements such as rams, the latter being influenced by pressure transmitted by respective branches allocated to the individual wheel suspensions.

Advantageously, individual springs for the various wheels are provided in addition to the common spring. To this end, a second branching device is provided before each bifurcated connection, and in said second branching device the force received from the associated wheel is branched so that some of such force is transmitted to the said bifurcated connection and some to a spring bearing against the vehicle. In apparatus in which the force is transmitted by a hydraulic or pneumatic medium the second branching device can comprise a cylinder which bears resiliently against the vehicle and which has a piston connected to the wheel support and which has a pressure chamber from whence a pipe extends to the said bifurcated connection. The second branching device can also take the form of a shock absorber, more particularly by the provision, in the cylinder above the piston connected to the wheel support, of a piston which is rigidly secured to the vehicle and which is formed with narrow passages for the hydraulic or pneumatic medium. In this case the transmission medium can be conveyed from the cylinder pressure chamber to the bifurcated connection through the hollow piston rod of the

[*Price 3s. 6d.*]

piston rigidly secured to the vehicle.

An embodiment of the invention is illustrated by way of example in the accompanying drawings wherein:—

Fig. 1 diagrammatically illustrates a complete installation in accordance with the invention, and

Fig. 2 is a view to a larger scale of one of the wheel springs and shock absorbers seen in Figure 1, but in a slightly modified form.

Reference numerals 10, 11, 12, 13 denote the axles of the right-hand front wheel, left-hand front wheel, right-hand back wheel and left-hand back wheel, respectively, of a motor vehicle. Each axle is connected by way of a piston rod 14 to a piston 15 slidable in a cylinder 16. Each cylinder 16 bears against the vehicle body 18 by way of its respective coil spring 117, 217, 317, 417. A piston 19 is rigidly secured to the body 18 by means of a rod, and the said piston 19 is formed with narrow bores 20. Pipes 22 to 25 connected with respective cylinder chambers 21 between the two pistons 15 and 19, have each a bifurcated joint provided with two branches for connection with respectively two pipes 122 and 222, 123 and 223, 124 and 224, and 125 and 225. The pipes 122 to 125 extend to a compensating device 26, while the pipes 222 to 225 extend to a spring 27 common to all of the suspensions.

The compensating device 26 comprises a double cylinder 28, that is to say two cylinders disposed end to end with a partition 29 between them. A piston 30 moves in one part of the double cylinder and a piston 31 moves in the other part thereof. The pistons 30, 31 are rigidly secured to one another by a rod 32 which passes through the partition and slides in a bearing therein. The effective cross-sectional area of the pistons on the free side has the reference 42, while the effective cross-sectional area of the pistons on the side of the piston rod 32 has the reference 41. Figure 1 makes clear how the pipes 122 to 125 are connected with the various chambers enclosed between the cylinder walls and the pistons, the pipes 122, 123 from the front wheel suspensions being connected to respective cylinder parts on the small area side of the pistons 30 and 31 and the pipes 124, 125 from the rear wheel suspensions being connected to the outer ends of respective cylinders on the large area side of the pistons 30, 31.

The pipes 222 to 225 extend each one to respective cylinders 33 to 36 of small rams rigidly interconnected by a crosshead 37 of a larger ram 38 which extends into an oil chamber 39 of a hydropneumatic spring comprising an air chamber 40.

Figure 2 shows in constructional detail a combined spring and shock absorber arrangement similar to that seen in Figure 1 near each road wheel and the same elements have the same reference as in Figure 1. In contrast to Figure 1, the pipe 22 in this modification is provided by a bore extending through the rod of the piston 19.

The operation of the device will be explained with reference to various kinds of spring action.

1. *Relative upward movement of all four wheels.*

With such parallel springing the pressure in all the pipes 22, 122, 222, 23 etc., 24 etc., 25 etc., rises because all the pistons 15 rise and therefore raise the cylinders 16 against the force of the springs 117, 217, 317 and 417, this rising of the cylinders 16 being damped because of the narrow passages 20 in the pistons 19, and the pressure in the pipes 22 to 25 rising correspondingly. The pressure increase in the pipes 122 to 125 has no further result because the pressure from each front wheel is opposed to the pressure from a respective rear wheel in the cylinders 28 so that the piston unit 30, 31 remains stationary. On the other hand, the pressure rises in the pipes 222 to 225 so that the rams in the cylinders 33 to 36 act upon the crosshead 37 to move the ram 38 further into the hydropneumatic spring 39, 40. As a result therefore, all the springs 117, 217, 317, 417 and 27 respond. If the spring 27 is rendered soft, a very soft parallel springing can be provided.

2. *Inclination on curves.*

When the vehicle passes around a left-hand curve for example, the pressure in the pipes 22, 122, 222, and 24, 124, 224, rises to the same extent in both sets of pipes, but the pressure in the pipes 23, 123, 223, and 25, 125, 225 decreases. Hence there is no movement of the crosshead 37 and ram 38 and the spring 27 is not affected. The compensating device can be in equilibrium only if the pressure difference between the pipe 22 and the pipe 23 is greater in the ratio of the surface 42 to the surface 41 than the pressure difference between the pipes 24, 25. Hence oversteer or understeer can be controlled by the proportioning of the surfaces 41 to the surfaces 42, since oversteer or understeer depends upon the ratio of the said pressure differences. The inclination of the vehicle when travelling around curves is determined solely by the hardness of the springs 117, 217, 317 and 417 but not by the spring 27.

3. *Upward springing movement of the wheels of one axle and downward springing movement of the wheels of the other axle (pitching).*

In this case there is, for instance, a pressure rise in the pipes 22, 23. The corresponding pressure rise in the pipes 122, 123 does not cause a movement of the piston unit 30, 31.

Similarly, the compensating device 26 is unaffected by the pressure drop in the pipes 24, 25, 124 and 125 such as occurs, for instance, with pitching due to a brake application. Nor does the spring 27 respond, since although the pressure applied to the rams in

the cylinders 33, 34 rises, [redacted] pressure applied to the rams in the cylinders 35, 36 decreases correspondingly. Hence brake pitching is determined solely by the springs 117, 217, 317 and 417.

4. *Movement in the same direction of diagonally placed wheels.*

If, for instance, the left front wheel and the right back wheel rise, there is first of all a pressure rise in the pipes 23, 24. The piston unit 30, 31 therefore moves to the right until the pressure in all four pipes 22 to 25 is the same as before. Hence twisting strain is not applied to the frame or vehicle body.

The invention is not limited to the embodiment illustrated.

WHAT WE CLAIM IS:—

1. Spring suspension compensating arrangement for vehicles, characterised in that there extends from each individual wheel suspension a bifurcated connection providing two branches, one branch being adapted for the transmission of force from its wheel suspension to a spring common to all of the suspensions, and the other branch being adapted for the transmission of force from its wheel suspension to a compensating device adapted for producing a predetermined relationship between the forces received by the individual wheel suspensions.

2. Spring suspension compensating arrangement according to claim 1, wherein the forces transmitted hydraulically or pneumatically and the compensating device comprises two pistons, working in cylinders, the two sides of each piston having different operative surface areas acted upon respectively by pressure produced by one front wheel suspension and by one back wheel suspension.

3. Spring suspension compensating arrangement according to claim 2, wherein the two pistons are interconnected by a piston rod, the two cylinders being disposed in end to end relation and being separated by a partition through which the said rod is slidable.

4. Spring suspension compensating arrangement according to claim 3, wherein the two cylinders are of one and the same diameter and the piston rod extends only between the two pistons.

5. Spring suspension compensating arrangement according to claims [redacted]4, wherein the common spring, which may be hydropneumatic, is acted upon by an element such as a ram which in turn is acted upon by individual elements such as rams, the latter being influenced by pressure transmitted by respective branches allocated to the individual wheel suspensions.

6. Spring suspension compensating arrangement according to any one of claims 1 to 5, a second branching connection is provided before each said bifurcated connection, said second branching device being adapted so that some of the force received from the associated wheel suspension is transmitted to the said bifurcated connection, and some to a spring bearing against the vehicle.

7. Spring suspension compensating arrangement according to claim 6 and in which the forces are transmitted hydraulically or pneumatically, characterised in that the said second branching device comprises a cylinder which bears resiliently against the vehicle and which has a piston connected to the wheel support and which has a pressure chamber whence a pipe extends to the said bifurcated connection.

8. Suspension spring compensating arrangement according to claims 6 and 7, wherein the said second branching device is also formed as a shock absorber, more particularly by the provision, in the cylinder above the piston connected to the wheel support, of a piston which is rigidly secured to the vehicle and which is formed with narrow passages for the hydraulic or pneumatic medium.

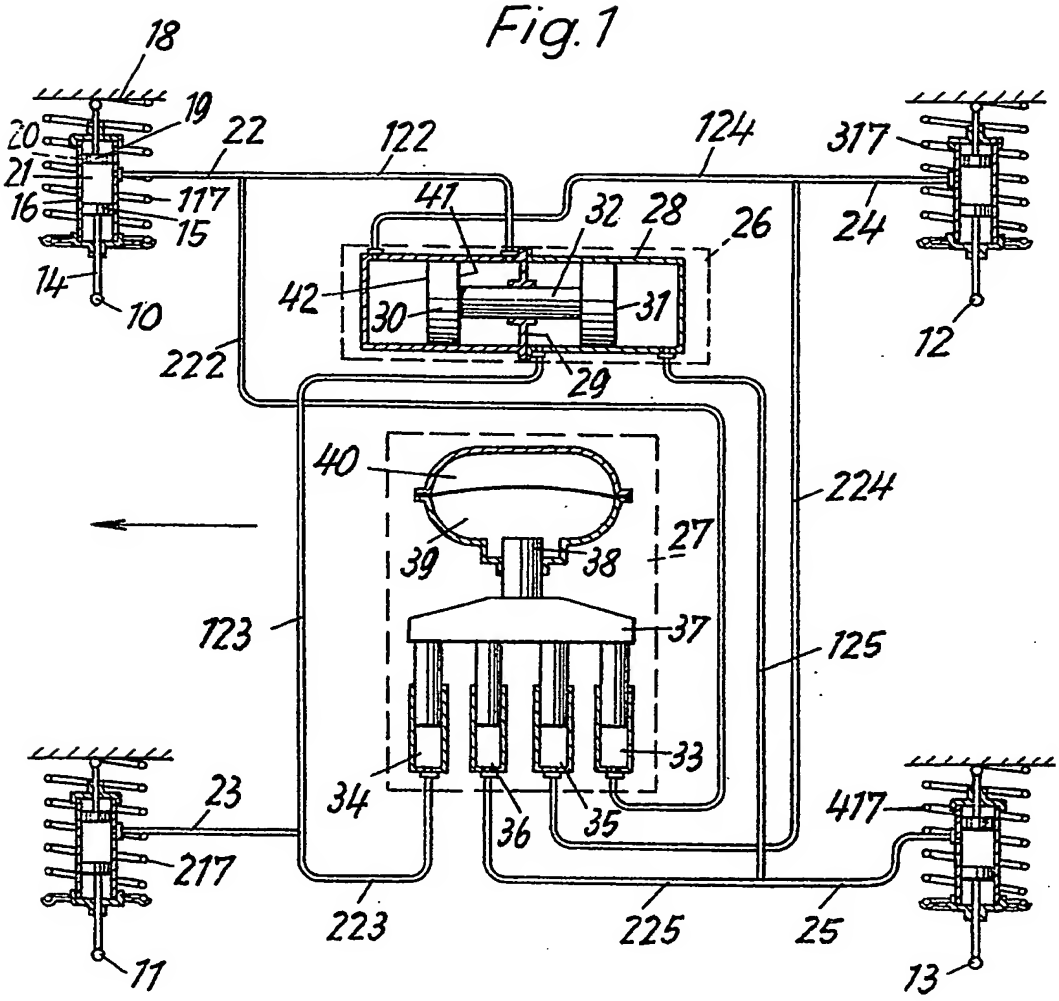
9. Suspension spring compensating arrangement according to claim 8, wherein the transmission medium is conveyed from the cylinder pressure chamber associated with the second branching device to the said bifurcated connection through a bore in the rod of the piston rigidly secured to the vehicle.

10. Suspension spring compensating arrangement for a vehicle substantially as hereinbefore described with reference to Figure 1, or as modified with reference to Figure 2, of the accompanying drawings.

JENSEN & SON,
77, Chancery Lane,
London, W.C.2.
Chartered Patent Agents.

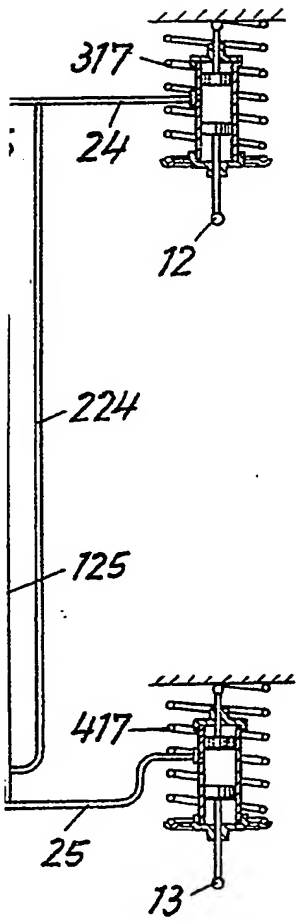
Bournemouth: Printed for Her Majesty's Stationery Office, by Richmond Hill Printing Works Ltd.—1960.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

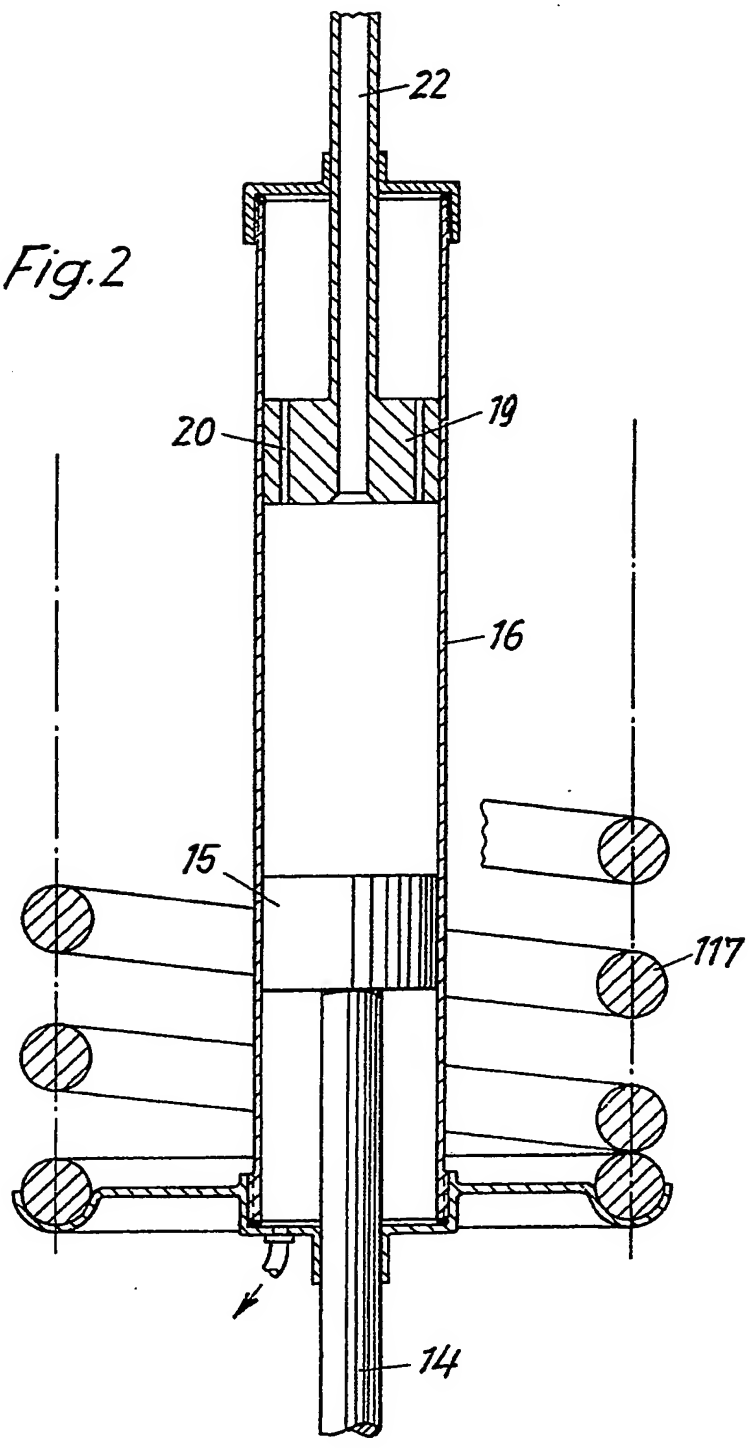
Fig. 1



844,145 COMPLETE SPECIFICATION
2 SHEETS

Fig. 2





844,145 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 2

Fig. 1

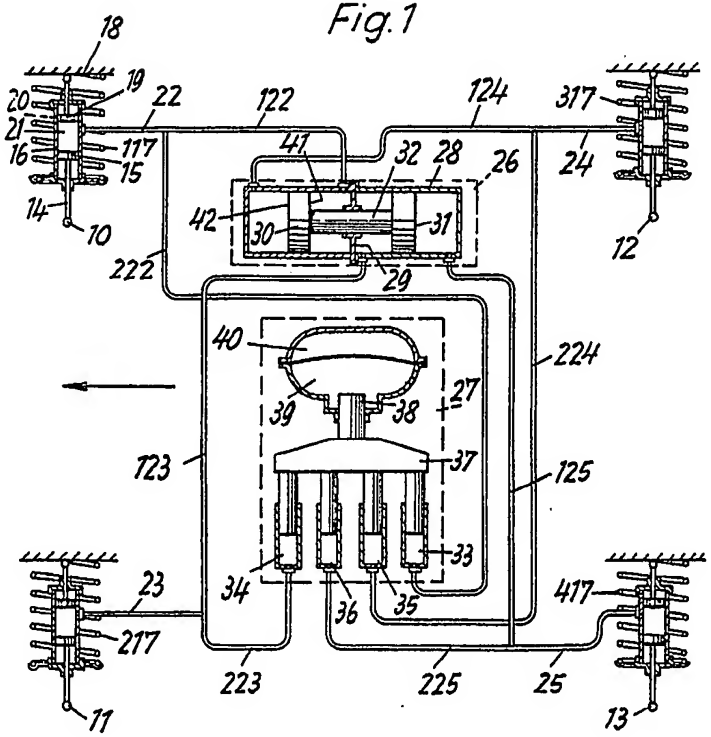


Fig. 2